U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

REPORT ON SEDIMENTATION SURVEY OF LAKE EDDLEMAN

GRAHAM, YOUNG COUNTY, TEXAS

By

James A. Ogle
Engineering Aide

Graham W. Renfro
Geologist

Temple, Texas
August, 1954

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United States Department of Agriculture
Soil Conservation Service

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INTRODUCTION

Lake Eddleman was constructed in the latter part of 1928 and early 1929 to provide water supply for the city of Graham, Texas. Total cost of the reservoir, including the dam, land costs, clearing, and building of roads and pipelines was $225,000.

A cooperative detailed sedimentation survey of the lake by the Soil Conservation Service and the city of Graham was authorized in May 1954. A survey party consisting of one Soil Conservation Service employee and two city employees was formed and the survey was conducted during the period May 13-19.

Previous Investigations:

A reconnaissance sedimentation survey of Lake Eddleman was made in 1941 by the Soil Conservation Service. Results of this survey showed that the lake was receiving sediment at the rate of 0.83 acre-foot per square mile of drainage area annually and that its capacity was being reduced 0.53 per cent each year. A comparison of the rates of sedimentation found in the 1929-1941 and 1941-1954 periods is not possible because of the reconnaissance nature of the first survey.

Objectives of the Investigation:

1. To determine the original and present capacity of Lake Eddleman and its long-term average annual loss of capacity by sedimentation.

2. To determine the rate of sediment production per unit of drainage area, for use in making estimates of rates of silting in other reservoirs in the Palo Pinto physiographic area.

3. To determine the principal sources of sediment in the drainage area, the extent to which the drainage area is controlled by land treatment practices and the amount and kind of practices yet required to

insure a declining sedimentation rate and prolongation of the useful life of the reservoir.

4. To furnish a basis for estimating the date at which the declining storage capacity and increasing water use will necessitate additional water supply.

THE DAM AND RESERVOIR

Lake Eddleman is located about two miles north of Graham, Texas. The dam is on Flint Creek, about one-half mile above its confluence with Salt Creek, which empties into Possum Kingdom Lake.

The dam is an earth fill 1,850 feet long and extends in an east-west direction across Flint Creek. The upstream slope is 3:1 and the downstream slope is 2:1. The highest point on the dam is 58 feet above the stream bed. The dam has a crest width of 20 feet and a maximum base width of 310 feet. Rock riprap protects the upstream face of the dam from wave action.

The spillway is located at the west end of the dam and drains west about 600 feet into Salt Creek. It is 320 feet wide and has a one-foot band of concrete set in the bedrock material. Other outlets are three 24-inch sluice gates, one 12-inch mud valve and one 16-inch water line to the filter plant which is located about one and one-half miles south and slightly east of the lake on the east bank of Salt Creek.

Figure 1 shows the surface area of the lake. The reservoir basin has steep side slopes throughout its main body and almost a flat bottom. The maximum present depth of water is 39.5 feet. The surface area of the lake is 373 acres and the average present depth of water at spillway stage is 13.6 feet. The average depth at the date of completion was

15.0 feet, and maximum depth 45 feet. The total original capacity of 6,583 acre-feet has been reduced 666 acre-feet by sedimentation. See Table 1, Reservoir Sedimentation Data Summary Sheet for detailed summary of survey results.

THE WATERSHED

The area of the watershed including the lake, as determined by planimetric measurement of aerial photographs (Scale 4" = 1 mile), is 42 square miles. It lies in an east-northeast direction from the lake and is roughly rectangular in shape. A map of the watershed area is shown in Figure II.

Physiography, Geology and Soils:

Lake Eddleman and its drainage area are located in the Palo Pinto Section of the Central Lowland physiographic province. The underlying limestones, shales, sandstones and conglomerates belong to the Cisco group of Upper Pennsylvanian age. The topography is gently to moderately rolling with the exception of an area about 6 or 7 square miles in extent immediately north and east of the lake, which is steeply rolling and is occupied by numerous ridges.

The soils in the watershed are largely deep, fine- to medium-textured and slowly to moderately permeable. Approximately 10 percent of the soils are shallow and very shallow, fine- and medium-textured.

An average of 45 percent of the watershed area has been cultivated during the period of record, chiefly to small grains and cotton. The remaining 55 percent has been rangeland which has only fair or poor native grass cover at present.

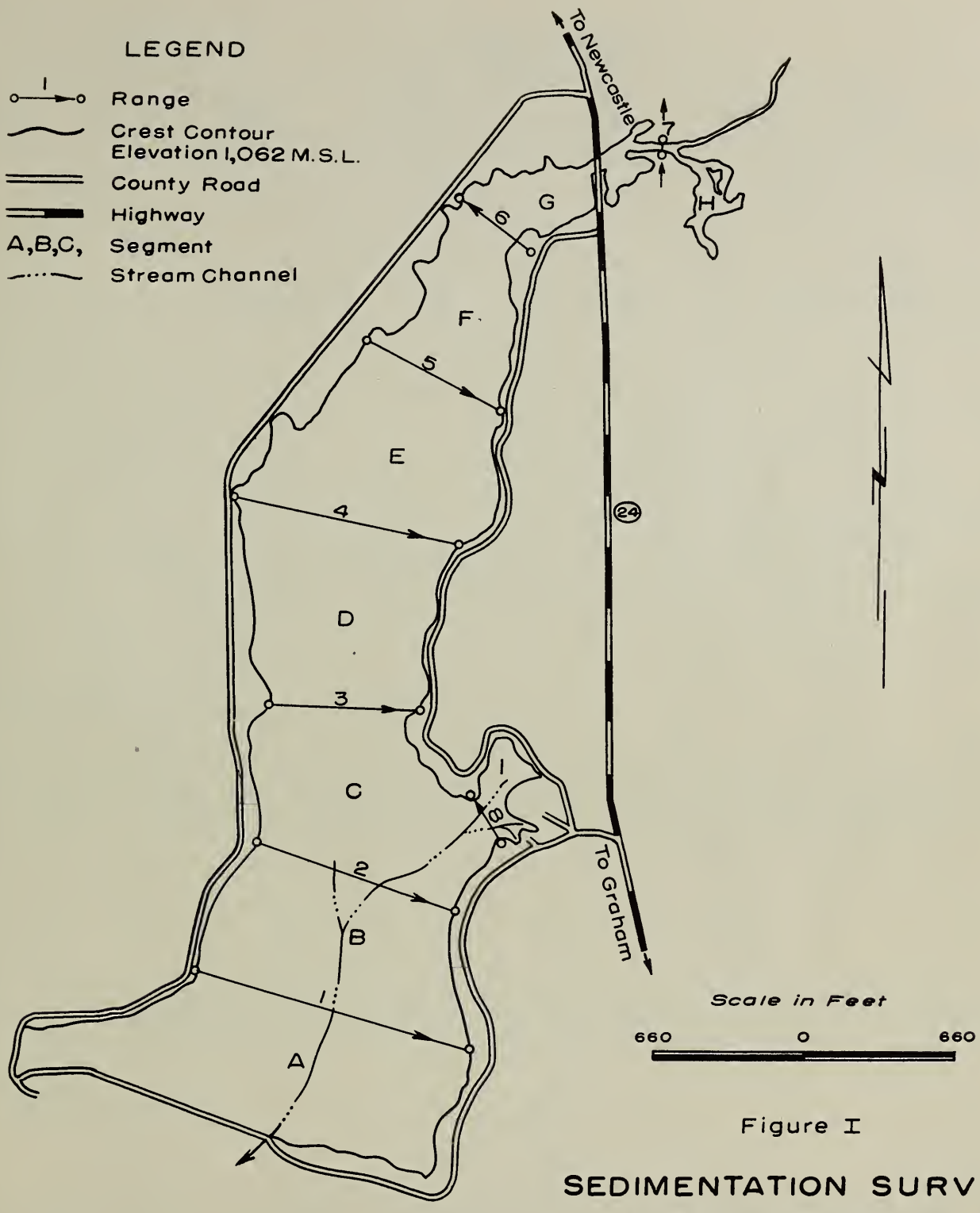


Figure I

SEDIMENTATION SURVEY
LAKE EDDLEMAN
GRAHAM, YOUNG CO., TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

REFERENCE

CARTOGRAPHIC APPROVAL TECHNICAL APPROVAL

COMPILED TRACED CHECKED DATE

6-9-54 4-L-9135

TABLE 1

U.S. DEPARTMENT OF AGRICULTURE — SOIL CONSERVATION SERVICE

RESERVOIR SEDIMENTATION DATA SUMMARY

Lake Eddleman
NAME OF RESERVOIR

Brazos River
DATA SHEET NO.

DAM

1. OWNER: City of Graham	2. RIVER: Flint Creek	3. STATE: Texas
4. SEC. TWP. RANGE: Long. 98.37 Lat. 33.08	5. NEAREST TOWN: Graham	6. COUNTY: Young
7. STREAM BED ELEV.: 1,011	8. TOP OF DAM ELEV.: 1,075	9. SPILLWAY CREST ELEV.: 1062.06

RESERVOIR

10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. SURFACE AREA ACRES	13. STORAGE ACRE-FEET	14. ACCUMULATED ACRE-FEET	15. DATE STORAGE BEGAN
a. FLOOD CONTROL					
b. POWER					Feb. 1929
c. WATER SUPPLY	1,062.06	373	6,583	6,583	16. DATE NORMAL OPER. BEGAN
d. IRRIGATION					
e. CONSERVATION					
f. INACTIVE					Feb. 1929

17. LENGTH OF RESERVOIR: 1.75 MILES — AV. WIDTH OF RESERVOIR: 0.31 MILES

WATERSHED

18. TOTAL DRAINAGE AREA: 42 SQ. MI.		22. MEAN ANNUAL PRECIPITATION: 27.8	INCHES
19. NET SEDIMENT CONTRIBUTING AREA: 41.4 SQ. MI.		23. MEAN ANNUAL RUNOFF: 2.56	INCHES
20. LENGTH: 11 MILES	AV. WIDTH: 3.8 MILES	24. MEAN ANNUAL RUNOFF: 137 Ac.ft./sq.mi.	
21. MAX. ELEV.: 1,011	MIN. ELEV.: Approx. 1250	25. CLIMATIC CLASSIFICATION: Sub-humid	

SURVEY DATA

26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA ACRES	32. CAPACITY ACRE-FEET	33. C/W RATIO AC.-FT. PER SQ. MI.
Feb. 1929	0	0	-	-	373	6,583	157
May 13-19, 1954	25.25	25.25	Range Detail	8 Ranges	373	5,917	141

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION	35. PERIOD WATER INFLOW ACRE-FEET			36. WATER INFL. TO DATE AC-FT.	
		a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	a. MEAN ANNUAL	b. TOTAL TO DATE

26. DATE OF SURVEY	37. PERIOD SEDIMENT DEPOSITS ACRE-FEET			38. TOTAL SED. DEPOSITS TO DATE ACRE-FEET.		
	a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR
May 13-19, 1954	666	26.4	0.64	666	26.4	0.64

26. DATE OF SURVEY	39. AV. DRY WGT. LBS. PER CU. FT.	40. SED. DEP. TONS PER SQ. MI.-YR.		41. STORAGE LOSS PCT.		42. SED. INFLOW PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANNUAL	b. TOT. TO DATE	a. PERIOD	b. TOT. TO DATE
May 13-19, 1954	49.2	687	687	0.40	10.12		

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET ABOVE, AND BELOW, CREST ELEVATION											
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION											

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGH OF RESERVOIR													
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW AC.-FT.

46. ELEVATION-AREA-CAPACITY DATA

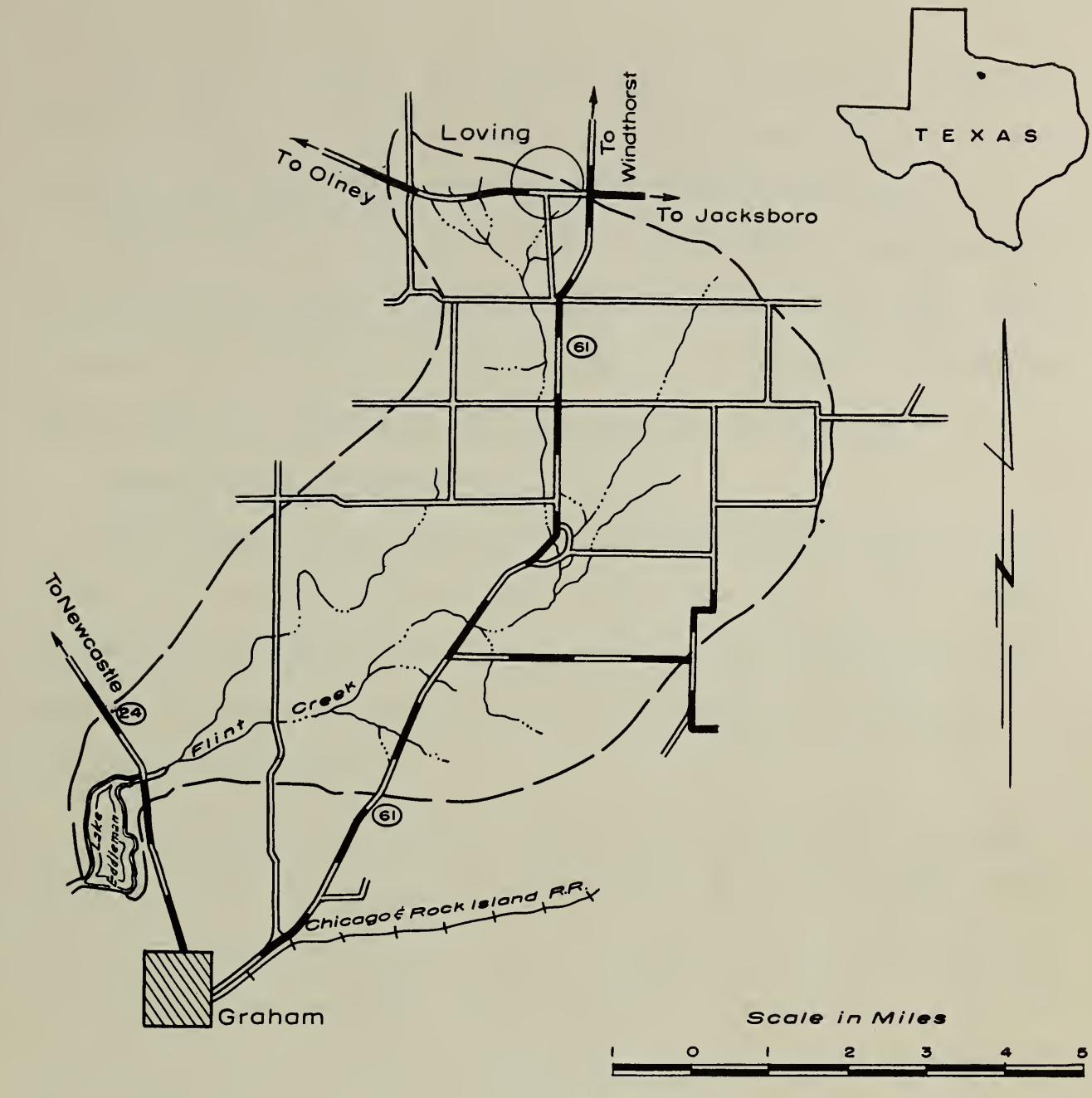
ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY

47. REMARKS AND REFERENCES

Land Use - 55% pasture, 45% cultivated during period of record.
C/I Ratio - 1.15 in 1929, 1.03 in 1954.
Estimated average trap efficiency - 97%.
Total annual sediment load adjusted for trap efficiency 0.66 acre-foot per square mile.

48. AGENCY SUPPLYING DATA Soil Conservation Service, Temple, Texas 49. DATE May 27, 1954

AGR-SCS-BELTSVILLE, MD. 1958 SEPTEMBER 1950



LEGEND

- Paved Road
- County Road
- Drainage Area Boundary
- Drainage System

Figure II

WATERSHED AREA LAKE EDDLEMAN GRAHAM, YOUNG CO., TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

REFERENCE

CARTOGRAPHIC APPROVAL TECHNICAL APPROVAL

COMPILED TRACED CHECKED DATE

6-9-54 4-L-9136

This land use pattern has existed during the life of the reservoir (25 years) with the exception of approximately 3 percent of the drainage area which has been retired from cultivation during that time.

Erosion rates in the watershed range from slight to moderate with a few localized areas of moderately severe erosion on the steep, shallow rangeland area previously mentioned. Most of the sediment results from sheet erosion of watershed land, particularly cultivated land.

Character and Distribution of Sediment:

The sediment in the lake ranges in texture from fine sand to clay. A total of five undisturbed sediment samples was taken during the survey. Analyses of the samples to determine grain size and volume weight were made by the Soil Conservation Service Soil Mechanics Laboratory at Albuquerque, New Mexico.

The average textural distribution of all samples was 5.7 percent fine and very fine sand, 34.1 percent silt and 60.2 percent clay. The bulk of the sandy sediment was found on Range No. 5 near the upper end of the lake. Sand and silt content decreased toward the dam, where the majority of the clay sediment is deposited. The average dry weight of the 5 samples was 49.2 pounds per cubic foot.

The sediment is quite evenly distributed across the submerged valley flat and has an average thickness over the main body of the lake of 1.45 feet. The sediment becomes deeper in the old channel where the greatest thickness found was 5.4 feet.

Table 2 shows the capacity loss of each segment of the lake and the proportion of the total sediment contained by it. It shows that the highest percent of capacity loss has occurred in segments F, G and H,

Table 2
Segment Data
Lake Eddleman

Segment	Surface Area (Acres)	Original Capacity (Ac.-Ft.)	Capacity At Date of Survey (Ac.-Ft.)	Sediment Volume (Ac.-Ft.)	Capacity Loss (Percent)
A	74.0	1,826	1,675	151	8.27
B	60.8	1,419	1,198	221	15.6
C	61.6	1,284	1,194	90	7.01
D	59.2	994	919	75	7.55
E	58.8	660	596	64	9.70
F	30.8	229	192	37	16.2
G	15.2	86.4	66.2	20.2	23.4
H	5.2	17.3	13.6	3.7	21.4
I	7.6	67.5	63.2	4.3	6.37
Total or Average	373	6,583	5,917	666	10.1

which form the uppermost portion of the lake. However, the greatest volumes of sediment are found in segments A and B which are nearest the dam.

Survey Methods and Calculations:

Standard procedure of the Soil Conservation Service was used in the survey. Equipment consisted of a range cable, used to accurately measure distances, silt rods and spuds for the measurement of sediment and Ohio-type sediment sampler. Water depth and sediment measurements were made at 50-foot intervals on all ranges and corrected to spillway level. Segment letters, range numbers and the direction of the traverse on each range are shown in Figure I.

A total of 228 water and sediment measurements were made. Volumes of water and sediment were calculated using the prismoidal formula as described by Eakin and Brown in U.S.D.A. Technical Bulletin No. 524, "Silting of Reservoirs."

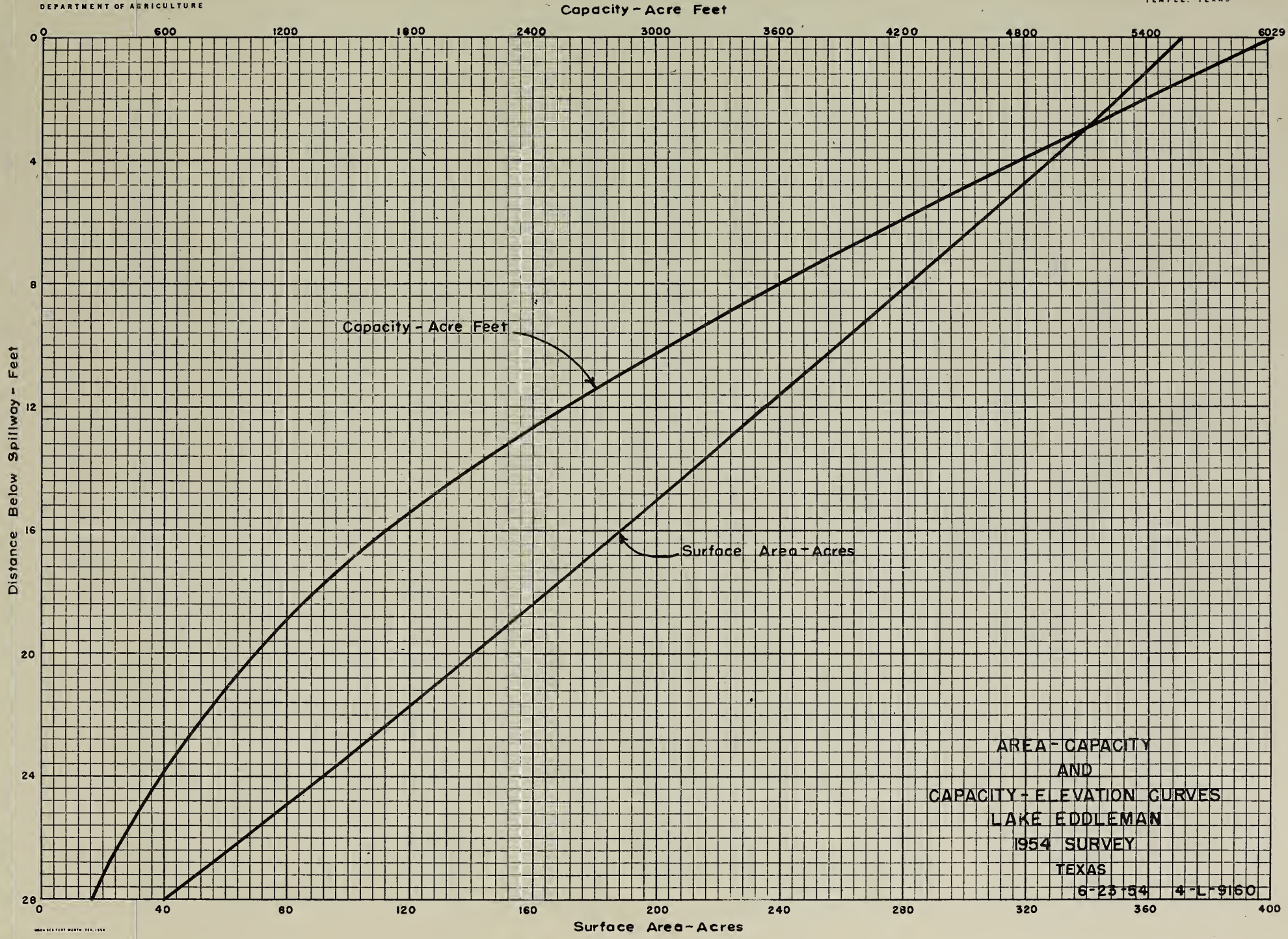
Area-capacity and capacity-elevation curves were constructed using a contour map plotted from the present water depth measurements taken during this survey. See Figure III.

ADEQUACY OF CITY WATER SUPPLY

The rate of water use from Lake Eddleman has increased from 156,923,000 gallons in 1930 to 358,632,000 gallons in 1952 which is the peak year of water usage to date. In 1930 the average daily use per capita was 86 gallons. In 1940 this daily per capita use had increased to 110 gallons and by 1950 the amount had increased to 139 gallons per day. The average annual increase in population from 1890 to 1950 was 148.

UNITED STATES
DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE
TEMPLE, TEXAS



AREA - CAPACITY
AND
CAPACITY - ELEVATION CURVES
LAKE EDDLEMAN
1954 SURVEY
TEXAS
6-23-54 4-L-9160

The total original capacity of the lake was 2,145,077,100 gallons. Sediment has reduced this capacity at the present time to 1,928,030,300 gallons or at the rate of 8,596,000 gallons per year. Although this annual rate of capacity loss probably insures a continuing water supply for several years, the total useful life of the lake can be prolonged by intensive conservation treatment in its watershed.

SOIL CONSERVATION

Soil conservation practices on the watershed contributing to Lake Eddleman will tend to stabilize streamflow, reduce peak rates of runoff from many storms and increase the low-water flow of Flint Creek. Thus, the net amount of water available to the lake would not decrease if complete conservation treatment was put into effect on the entire watershed. A reduction in peak runoff rate into the lake would be beneficial not only by reducing sediment transported to it by a storm but by reducing the maximum discharge through the spillway. Increased low-water flow to the lake following a rainy season would tend to maintain the water level in the lake at a more uniform height and more nearly at spillway crest.

A study of Lake Eddleman's watershed was made during the survey and the total amount of the different conservation practices now in effect was determined. In addition, an inventory was made of the kinds and amounts of practices which were needed on the untreated portions of the watershed. Following is a summary discussion of these findings:

The total watershed area is 26,507 acres, exluding the lake area, of which approximately 45 percent, or 11,930 acres, is in cultivation. An estimated 60 percent of the cultivated land is devoted to small grain;

the remainder to row crops. Fifty-five percent of the watershed, or 14,577 acres, is used as pasture or rangeland on which the grass cover is either poor or fair.

Conservation treatment on lands in the watershed has been conducted under the direction of the Upper West Fork Soil Conservation District, assisted by the Soil Conservation Service Work Unit at Graham. A total of 12,252 acres is at present under cooperative agreement with the district. Of this total acreage, 2,270 acres have received complete conservation treatment, while 520 acres have received no treatment. The remaining 9,462 acres are in various stages of completion of the needed conservation treatment as follows:

Terracing -	90 percent complete
Cover Crop Establishment -	40 percent complete
Reseeding of Areas Retired from Cultivation -	70 percent complete

Range improvement - All the rangeland needs more intensive grazing control to improve the native grass cover.

Of the 520 acres under agreement where no land treatment has been established, approximately 100 acres should be terraced.

There are 14,255 acres in the watershed which are not under cooperative agreement with the district. However, a portion of this area has received some conservation treatment. The remaining land treatment needs are estimated as follows:

Cultivated land - 6,582 acres

Terracing and contouring -	Approximately 4,937 acres
Cover crops -	Approximately 5,595 acres
Reseeding -	Approximately 660 acres

Rangeland - 7,673 acres

All of this acreage needs intensive grazing control to improve the native grass cover which is either fair or poor.

It is estimated that if the untreated portion of the watershed receives the required conservation treatment, the annual rate of sediment contribution to Lake Eddleman will be reduced by approximately 45 percent.

It would be advantageous to the city of Graham to assist the Soil Conservation District and the farmers in the watershed in the installation of the necessary watershed treatment.